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Evaluation of Technical Efficiency of Sweet Corn Production among Smallholder Farmers in Njoro district, Kenya

E. Ngenoh[1]* B. K. Mutai[1] P. K. Chelang'a[2] W.Koech[1]
1.Department of Agricultural Economics and Agribusiness Management, Egerton University,P.O. Box 536 Egerton, Kenya
2.International Livestock Research Institute,P.O. Box 30709-00100 Nairobi, Kenya

Abstract
The National Agriculture Policy stresses the involvement of all stakeholders in decision making as one of the major strategies for eradicating poverty and increased productivity. Therefore, in recognition to the economic importance of horticulture to Kenya, technical efficiency of sweet corn production was evaluated to substantiate the paradox behind persistent reduction in productivity that impedes the development of the vibrant industry. A semi-structured and pre-tested questionnaire was used to collect data from smallholder producers through face-to-face interview. The census and purposive sampling methods were employed to obtain 76 respondents who were subjected to a stochastic production frontier model to estimate technical efficiency of sweet corn production. The results showed a mean efficiency score of 74% indicating that there was a 26% allowance for improvement. Land tenure with title ($p \leq 0.05$), hired labour ($p \leq 0.05$) and off-farm activities ($p \leq 0.1$) with positive effects while age ($p \leq 0.05$) and gender of the household head ($p \leq 0.1$) with negative effects on technical inefficiency. Therefore, there exists opportunity to improve efficiency in production given existing farm technologies more so if they embrace the use of family labour effectively and deterministic lawful land ownership. Besides, off-farm activities would reduce the overreliance on farming and promote higher returns by boosting on efficient resources use.
Keywords: Technical, Efficiency, Farm technologies, Sweet corn, Stochastic frontier

Introduction

Over several decades, agriculture has been seen as a vital development tool that can be used to reduce rural poverty, particularly in sub-Sahara Africa (World Development Report, 1982; Adelman, 1984; Mellor and Johnston, 1984; World Development Report, 2008). Previous studies have shown that Gross Domestic Product (GDP) growth in agriculture is at least twice as effective in reducing poverty as compared to GDP growth from non-agricultural based countries (World Development Report, 2008). The greatest challenge facing Kenya and Sub-Saharan Africa in general is increasing per-capita food production and raising rural income. This sector accounts for about 24% of Kenya's Gross Domestic Product (GDP) and almost 80% of Kenya's population live in rural areas thus depend on agriculture for their livelihood and most are classified as smallholders (Kuyiah *et al*., 2006).

The horticulture sub-sector is currently ranked second to tea in terms of foreign exchange earnings. The success of the sub-sector has seen the export of horticultural produce rising from 1,480 tonnes in 1968 to 193, 000 tonnes in 2007 fetching over US $700 million during this period (Horticultural Crop Development Authority, 2007). The major export market is the European Union countries taking 80% of the exports; with the UK, Netherlands and France being the main markets (Horticultural Crop Development Authority, 2007; Minot and Ngigi, 2004). This subsector has become a recommendable diversification strategy for producers as horticultural crops often generated higher returns per hectare than staple food crops. The main vegetable crops grown for export in Kenya include; garden beans, garden pea, sugar snap pea, mange tout, Sweet corn, baby corn and French beans.

Sweet corn, (*Zea mays L. Var. Saccharata*), is a type of maize which belongs to the grass family, Gramineae and is known as corn. A standard sweet corn is a mutant type of corn that differs from field or dent corn by a mutation at the sugary locus and it accumulates about two times more sugar than field corn and therefore will remain sweet about two to four days after harvest if refrigerated. According to (Marton *et al.*, 2007), there are several hundred sweet corn varieties that are currently available where selection is forwarded towards enlarging harvest in ways that will prolong the time of sugar converting into starch, in order to maintain its quality longer in time. The cobs are harvested when the kernels are pale yellow, plump and milky. Basically, it is marketed or exported as frozen vegetable since its post-harvest life is brief, respires at high rate and sugar is rapidly converted into starch. Sweet corn is a warm weather crop that grows best when temperatures range from 60 to 80° farads and the soil is well supplied with moisture. The plants grow in a variety of soil types, but growth is best in fertile, loamy, well drained soils of pH 5.8 to 6.5. Furthermore, sweet corn plants grow best

when exposed to full sunlight throughout the day, therefore the shady areas should be avoided (Schultheis, 1998).

The economic importance of sweet corn in the world includes its use in the manufacture of several byproducts such as cosmetics and glucose from starch while oils, glue, paints, varnishes and paper from fibres. In terms of nutrition, sweet corn succulent silks are rich in energy, protein and vitamin. In Kenya its uses is limited mostly to its production as a canned frozen vegetable for export or sold locally through supermarket chains while its stalks and other residues are an important livestock feed. Commercial sweet corn cultivation areas in Kenya are relatively minor compared with field cereal corn cultivation areas and is usually produced on relatively small, part-time family farms. It is also known that in the last few years the cultivation of vegetables has been affected mostly by climate change and has become dependent on high amounts of water to ensure good yields, but sweet corn is a relatively drought-tolerant crop that is adapted to a wide range of climates (Bray, 1997). The production and cultivation of sweet corn, rather than vegetables, is currently the most effective strategy when facing climate changes and soil characteristics, which plays a very important role in crop management. In spite of the economic importance of sweet corn for the Kenyan economy, yields have remained relatively low over the past years. According to Njoro Canning Factory, the contracted producers normally produce an estimated yield that ranges between 4.2 tonnes/acre and 5.7 tonnes/acre compared to the best expected optimum level of between 7.5 to 8.4 tonnes/acre per production season within the production area. The crop has over the years registered big fluctuations in terms of area, production and yields that have led the contractor to abandon the export market. This is because the factory is unable to meet that export market demand from the EU markets, which normally range between 40 to 60 ton/week compared to less than 30 ton/week the contracted producers are in position to produce. Therefore, the aim of this study was to provide insights on the producers' prevailing conditions of technical efficiency in order to provide necessary information to address the persistent low productivity of sweet corn among smallholders in Kenya.

Materials and Methods

Study area and data

The study was conducted in March 2010 in Njoro district, which is one of the districts that make up the Nakuru county of Rift Valley Province. Census method was used to identify the sweet corn producers because their population was small. A total of 34 sweet corn producers were selected and face-to-face interviews were conducted using a semi-structured and pre-tested questionnaire. During the study, the Exporters (contractors) officials and extension officers were used to assist in getting the desired number of respondents from the Sweet corn growing Extension Planning Areas (EPAs) together with the identification of sweet corn and non-sweet corn producers. For the non-sweet corn producers, purposive sampling method was used which involved purposively selecting the non-sweet corn producers and randomly selecting the desired number to be contacted, which were equal to the number of sweet corn producers contacted. Secondary data of production and marketing trends in Sweet corn production were obtained from the exporter (Njoro canning factory).

The model:

Stochastic frontier production function The concept of technical efficiency can be distinguished into three types of efficiency:

Technical efficiency,
Price or allocative efficiency and
Economic efficiency which is the combination of technical and allocative efficiency (Farrell, 1957).

The model estimation and the application of stochastic frontier production function to economic analysis assumed prominence in econometrics and applied economic analysis. According to Farrell, technical efficiency reflect the ability of the firm to maximize output for a given set of resource input while allocative (factor price) efficiency reflects the ability of the firm to use the inputs in optimal proportions given their respective prices and the production technology. Therefore, the model used in this paper was based on the one proposed by Coelli *et al.* (1995) and Battese *et al.* (1996) in which the stochastic frontier specification incorporates models of technical inefficiencies effects and simultaneously estimate all the parameters involved in the production function. The stochastic production frontier functional form, which specifies the production technique of the farmers, is expressed as follows:

$$Y_i = f(x_i\,;\beta)\exp(v_i - u_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where Y_i represents the output, which is measured in Kilograms (Kgs), x_i represents the quantity of input used in the production, v_i represents random errors assumed to be independent and identically distributed N(0, σ_v^2) and u_i represents the technical inefficiency effects assumed to be non-negative truncated of the half-normal distribution N(μ, σ_u^2).

The technical efficiency of individual farmers is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the level of input used by the farmer. Hence, the technical efficiency of the farmer is expressed as:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(x_i\,;\beta)\exp(v_i - u_i)}{f(x_i\,;\beta)\exp v_i} = \exp(-u_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Where Y_i represents observed output and Y_i^* represents frontier output. Farrell's measure of technical efficiency (TE_i), takes a value between zero and one. It indicates the magnitude of the output of the ith farm relative to the output that could be produced by a fully-efficient farm using the same input vectors

The stochastic frontier production function model of the Cobb- Douglas function form was employed in this study to estimate the farm level technical efficiency of Sweet corn farmers in Njoro district. The choice was made on the basis of the variability of agricultural production, which is attributable to climatic hazards, plant pathology and insect pests, on the one hand, and on the other hand, because information gathered on production is usually inaccurate since smallholder farmers do not have updated data on their farm operations.

The stochastic frontier method makes it possible to estimate a frontier function that simultaneously takes into account the random error term and the inefficiency component to every farmer. The Cobb-Douglas functional form were used because of its elegance, simplicity and ease of estimation and interpretation that makes the function to meet the requirement of being the self-dual and allowing an examination of technical efficiency. Based on this, the production technique of the farmer was assumed to be specified by the Cobb-Douglas frontier production function expressed natural log form as:

$$lnY_i = \beta_o + \sum \beta_i lnX_{ij} + v_i - u_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 13$$

Where - $\ln Y_i$ = Natural log of total Sweet corn output cost measured in (Kshs),

v = is the random error

u = inefficiency effect

β_i= parameters to be estimated

X_i is as defined earlier (is a vector of conventional production variable and fixed factors) such as;

lnAREA = Natural log of total area grown by Sweet corn in acres

*ln*FERT DAP= Natural log of the amount of fertilizers measured in (Kshs)

lnLABOUR = Natural log of amount of labour, which includes family and hired labour (Kshs)

lnFERT CAN = Natural log the total cost of topdressing fertilizers used in Sweet corn production (Kshs)

lnAGROCHEM = Natural log of cost of agrochemicals used in sweet corn production (Kshs)

lnSEED = Natural log of cost of seed used in sweet corn production (Kshs)

The study also estimated the inefficiency variables that affect the sweet corn producers' technical performance using the inefficiency model as specified by Battese, and coelli (1995), as shown:

$$u_i = \alpha_o + \sum_{i=1}^{n} \alpha_i z_i + w_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (14)$$

Where u_i is the inefficiency measure, Z_i is a vector of socio-economic factors affecting inefficiency which includes educational level of household head, household size, access to extension services, experience in growing Sweet corn, occupation of the head, degree of specialization, age, gender of household head, form of land ownership and whether the farmer uses family or hired type of labour. These were included in the model to indicate their possible influence on the technical efficiency of the farmer. w_i is the unobservable random variables and the α_0 and α_i's parameters to be estimated. The distribution of *ui* is usually assumed to be non-negative half normal, truncated normal, exponential or gamma (Kumbhakar and Lovell, 2000). Such restrictive assumptions about the distribution of *ui* may be considered as a weakness of SFA. The Cobb-Douglas (C-D) functional form is popular and is frequently used to estimate farm efficiency despite its known weaknesses of imposing several restrictions, including unitary elasticities of substitution, constant production elasticities and constant factor demand elasticities (Fuss *et al*., 1978)

Results and Discussion

Descriptive statistics

The results of the selected characteristics of the households are presented in Table 1 and Table 2. The results show that among the sweet corn producers, 44.1% were female and 55.9% were male. On the other hand, the non-sweet corn producers comprised of 24.1% female while the male constituted 75.9%. Therefore, this shows that male farmers head agricultural activities in the area. This may be because males are considered the owners of land and other production resources according to the African culture, (Owuor *et al*., 2006). The results on occupation indicates that, the sweet corn farmers are dominated by those who are purely famers which constitute 55.9% followed by those who are formally or informally employed which comprise of 32.4% and lastly 11.7% of those who are in business. On the other hand the non-sweet corn category constitute 37.9% of the employed (formally or informally), 34.5% of those engaged in business and 27.6% are those who are in farming as their main occupation. The farmers with farming as the main occupation tend to be technically efficient because they tend to adopt more agricultural technologies than those with other off-farm activities alongside farming despite the fact that off-farm income is used to finance agricultural activities (Akkaya 2007). In terms of education level, majority of the farmers were able to access education. The results show that 11.8% of the respondents did not access any education at all while 88.2% of the respondents got accessed to formal education. However, majority of them attained primary, secondary and tertiary/college level of education while very few attained university education. Among the sweet corn farmers, those with no formal education, with primary and secondary education were 11.8%, 32.4% and 17.6% respectively while those who attained tertiary/college and university level of education were 23.5% and 14.7% respectively. On the other hand, there was none of the non-sweet corn farmers who did not go to school, 24.1% were those with primary education level, 31.1% secondary education level, 27.6% attained college education level and 17.2% attained university level of education. Most of the farmers in the area had tertiary education and university education. Farmers with higher levels of education have a tendency of taking much of their time in other off-farm activities such as politics and other occupational duties at the expense of supervision of their farms. On the other hand, higher education level can be a necessary factor in disseminating information on new farming technologies since they are in better position to understanding them and can get access to them since they are in position to acquire them due to their off-farm income (Ajibefun and Aderinola, 2003).

The results on land tenure indicates that, among the sweet corn farmers 41.2% had no title deeds while 58.8% had title deed as part of their ownership of land. Among the non-sweet corn farmers, 72.4% of them had no title deeds while 27.6% had title deeds. The security of land access induces farmers to fully allocate the available resources in their land (Rana *et al*., 2000). As indicated by the results, the type of labour employed by the household was hired labour. Among the sweet corn farmers, only 5.9% used both family and hired labour, 14.7% used family and 79.4% used hired labour. On the other hand, 82.8% of the non-sweet corn farmers used hired type of labour, 13.8% were using family labour and only 3.4% used both family and hired labour type. This results conforms with the findings of Obwona (2006) who identified that hired workforce negatively impact on technical efficiency when dispersed over a large area since it is more costly to monitor and its output more difficult to measure, hence giving workers an incentive to shirk.

Table 4: Summary of the attributes of the farmers

Variable	*Sweet corn producer*		*Non-sweet corn producer*	
	Frequency	**%**	**Frequency**	**%**
Occupation				
Farmer	19	55.9	8	27.6
Businessperson	4	11.8	10	34.5
Employed	11	32.4	11	37.9
Gender				
Female	15	44.1	7	24.1
Male	19	55.9	22	75.9
Education Level				
None	4	11.8	0	
Primary	11	32.4	7	24.1
Secondary	6	17.6	9	31
Tertiary	8	23.5	8	27.6
University	5	14.7	5	17.2
Land Ownership				
With title deed	20	58.8	8	27.6
Without title deed	14	41.2	21	72.4
Labour Type				
Family	5	14.7	4	13.8
Hired	27	79.4	24	82.8
Family and Hired	2	5.9	1	3.4

The farmer with small household size in both categories had 1 person while the one with large household size had 13 people. The average household size for both categories was approximately 6 people. The sweet corn farmers had a minimum of 5 people and a maximum of 12 people while the non-sweet corn had a minimum of 1 person and a maximum of 13 people. The mean for the two categories of farmers were significantly different at 1% where for those who are sweet corn growers was 8 people and for the non-sweet corn was 5 people. It has been found that large household size positively influences technical efficiency through provision of sufficient family labour (Faturoti *et al*., 2006). Most of the sweet corn farmers were relatively older than non-sweet corn farmers who were relatively young as indicated by the mean age of 57 years and 38 years respectively in each category. The means were significantly different at 1% level. The youngest farmer among the sweet corn farmers was 27 years old while the age of the oldest farmer was 84 years. Among non-sweet corn, the youngest farmer was 26 years old and oldest farmer was 56 years old. Farmers with more years have acquired knowledge and skills necessary for choosing appropriate new farm technologies (Faturoti *et al*., 2006).

The results indicate that sweet corn farmer with the smallest land size had 0.25 acres and the one with the largest land size had 4.0 acres. However, among the non-sweet corn farmers, the smallest land size had 1.0 acres and the largest being 100 acres. There was a significant difference between the means at 5% level, where the average land size for sweet corn was 0.85 acres; while for the non-sweet corn farmers in the selected area was approximately 12 acres. Large farm sizes have been found to have positive effect on technical efficiency (Rana *et al*., 2000). All the respondents accessed extension services but the number of contact days during the growing season differed across the two categories of farmers. Among the sweet corn farmers, the mean number of contact days of extension was 12 days with the minimum of 6 days and a maximum of 18 days within the growing season. The non-sweet corn on the other hand had a mean number of 3 days of extension contact with some of the farmers having zero number of days and a maximum of 11 days during the growing season of a particular crop grown. When compared using t-test, the two means were significantly different at 1% level. According to Owuor and Ouma, (2009), extension is a factor, which is necessary for a positive effect on technical efficiency.

Table 5: Summary of the characteristics of farmers

Variable	*Sweet corn Producer*				*Non-Sweet corn Producer*				*t-test*
	Mean	**Min.**	**Max.**	**Standard Dev.**	**Mean**	**Min.**	**Max.**	**Standard Dev.**	
Age	56.71	27.00	84	10.16	37.45	26	56	7.72	-8.35
Household size	7.65	5.00	12	7.65	4.69	1	13	2.56	-5.19
Experience	6.94	3.00	10	1.80	0	0	0	0	-3.78
Extension Contacts	11.18	6.00	18	2.88	2.72	0	11	3.38	-10.71
Degree of specialisation	0.84	0.25	4	0.77	11.39	1	100	24.97	2.47

Model Results

The distribution of the farmer's technical efficiency is provided in Table 3 where the sweet corn farmers' technical efficiency is less than one (< 1) indicating that all the farmers were producing below the maximum efficiency frontier. The farmer's technical efficiency varied between 0.3145 and 0.9356 with a mean of 0.7410 (Appendix II). From the analysis, it shows that there was a generally high technical efficiency among the sweet corn farmers where by 91.18% of them produced above 0.50 efficiency index. The results further indicate that 61.76% of the sweet corn farmers produced above the estimated average technical efficiency index of 0.7410. This implies therefore that the potential for improving the production efficiency of sweet corn farmers is immense, since some farmers are operating as low as 31% level of efficiency. In other words, this means that sweet corn output can be increased with the current amount of inputs by simply improving the level of each input used. The distribution of technical efficiency suggests that potential gain among the sweet corn farmers is within the scope of increasing the output in the area by 26% through the adoption of the technological practices used by the best-practice farmer. The findings of this study is in agreement with the earlier studies conducted by Onyenweaku *et al.,* (2005) and Amaza *et al*., (2005), which indicated a wide gap between the maximum and the average technically efficient farmer on food crop production.

Table 6: Frequency distribution of technical efficiency of sweet corn farmers

Efficiency index	*Frequency*	*Percent of Farmers*
0.00-0.40	1.000	2.941
0.41-0.50	2.000	5.882
0.51-0.60	3.000	8.824
0.61-0.70	5.000	14.706
0.71-0.80	7.000	20.588
0.81-0.90	13.000	38.235
0.91-1.00	3.000	8.824
Total	34.000	100.000
Mean	0.741	
Minimum	0.315	
Maximum	0.936	

Source: Computed from MLE Results

The estimates of stochastic frontier production parameters are presented in Table 4. The estimated variables include all the direct inputs of production. The results indicate that the land size is significant at 5% with negative influence on technical efficiency. The negative effect of the land size was because most of the respondents were small-scale farmers and lack economies of scale. Land shortage would not only have a direct negative effect on production but also an indirect negative effect on output by reducing the marginal productivity of non-land inputs (Umoh, 2006). In addition, according to Blank (2005) he found that small and middle-sized farms maximise their household wealth rather than their farm income. This means that the households are not completely dependent on the farm in order to earn their living and hence causing inefficiency in production. The seed was significant at 1% level with a positive effect on technical efficiency, which conforms to a priori expectation. This indicates that higher seed rate results in high sweet corn population and subsequently high yield except where there is overcrowding leading to competition of available nutrients, which will consequently lead to lower yield (Pius and Odjuvwuederhie, 2006).

The estimated coefficient of household labour was negative and significant at 5% level. The negative effect of household labour on technical efficiency was inconsistent with the a priori expectation. This implies that the usage of hired labour by the sweet corn farmers increases the cost of production. The negative effect of the household labour variable could have been because sweet corn production is labour-intensive from land preparation to harvesting and therefore for optimum yield to be realized high cost of labour is required (Ajibefun and Aderinola 2003). Furthermore, the results show that agrochemicals were significant at 10% with positive influence on technical efficiency. This implies that, the use of agrochemicals reduces pest and disease infestation and hence increases output per unit of land. The results concurs with the findings of Owuor, (2002) who found that smallholder farmers rarely use chemicals in crop enterprises, and hence encounters the problems of pest and diseases which reduce their production output per unit area. This is because sweet corn farmers are producing under food safety standards, which required high quality produce. However, the estimated co-efficient of both fertilizer, DAP and CAN, have positive signs but they are not significant at any level of significant. The positive relationship between these variables and technical efficiency of the sweet corn production shows the importance of these inputs in enhancing the increasing level of output in the study area.

Table 7: Estimates for stochastic frontier production function of parameters.

Variables	*Coefficient*	*Standard error*	*P-value*
Production factors			
Constant	-3.5596	0.3514	0.0000
land size	-0.1154	0.0570	0.0430**
Labour	-0.5050	0.2098	0.0160**
Seed	0.6247	0.2175	0.0040***
Fertilizer(DAP)	0.0465	0.2117	0.4980
Fertilizer(CAN)	0.0034	0.0118	0.7730
Agrochemicals	0.1435	0.0273	0.0880*

*** (p<0.01) ** (p<0.05) *(p<0.10), Summarized from computer output (STATA)

Determinants of technical Inefficiency:

The source of inefficiency is examined by using the estimated co-efficient in Table 5 that is associated with the inefficiency variables. The co-efficient of occupation, household size, land tenure, type of labour, degree of specialisation, age, gender, level of education and extension contact were estimated. However, age and gender were negatively significant at 5% and 10% respectively. This therefore conforms to prior expectations. The implication is that those sweet corn farmers who were aged tend to be more efficient in sweet corn production and hence increase in the output level. This result conforms to the earlier studies conducted by Onu *et al.,* (2000), and Amaza and Olayemi (2000). The older sweet corn farmers are able to use up to date farm management methods acquired from more years of farming experience and hence more efficient. Older farmers are able to acquire technical knowledge through learning on the job by doing. Contrary, Owuor and Ouma, (2009) identified that older farmers are not able to use up to date farm management methods or are less adaptive to modern technologies.

Gender shows significant at 10% level with a negative co-efficient, which implies that it reduces technical inefficiency. In the study area, majority of households are headed by men, who are considered to be the owners of property, a factor that is common in African rural communities. Men in Africa have legal right to property, making them to be able to offer asset securities to access markets for inputs, hence making their activities comparatively well capitalized by taking the advantage of productive investment opportunities, which increases their per capita earnings. The findings of this study concur with the findings of Owuor *et al.,* (2006) who concluded that the households headed by female are less efficient due to their low levels of education in rural areas that reduces their ability to conceptualize technological information. The co-efficients of occupation, land tenure/ownership and hired labour used had positive influence on technical inefficiency. Both the labour and land tenure were statistically significant at 5%, while the occupation was statistically significant at 10% level.

The positive effect of hired labour on technical inefficiency may be because hired workforce is very costly in the area and thus raises cost of production. During peak season (planting and harvesting) there is shortage of labour and hence hired labour is a critical input. The results conforms with the findings of Ojo (2003) which concluded that Farmers should be encouraged to use more of the family labour on their farms than the costly hired labour so as to improve on their technical efficiency. Most of the farmers in the area do not prefer the use of family labour because they are engaged to other duties like children being in school, others in employment and some in business activities. The land tenure of individually owned land with title deed was significant at 5% with positive effect on technical inefficiency. This implies that there is an existence of flexibility in use of inputs, and accessibility to credit markets for the same. Despite that, there is a positive effect on technical inefficiency, which implies that there is a predominant association between constrained landholding and technical inefficiency. This suggests that for households with inadequate access to land to be technically efficient, ownership of land with title deed is necessary to enable them to achieve efficient use of available resources with flexibility of input use when making necessary investments. This was in line with the findings of Rana *et al*., (2000).

The results show that off-farm activities were significant at 10% with positive influence on technical inefficiency. This implies that most of the sweet corn farmers are taking much of their time in other activities such as politics and formal employment at expense of supervising their farms. The results conforms to the findings of Ojo (2003) which concluded that Farmers should be encouraged to use more time to supervise their farms so as to improve on their technical efficiency. From the results, the co-efficient of the household size had positive effect on technical inefficiency and statistically significant at 10%. This means households with larger household sizes were producing inefficiently. The reason may be that the available family labour was either not used or under-utilized in the production of sweet corn. The results were inconsistent with the findings of Ebong (2005) and Onyenweaku *et al.,* (2005), which identified a positive relationship between household size and technical efficiency among crop farmers. That is, the more the number of adult persons in a household, the more quality labour would be available for carrying out farming activities in timely fashion, thus making the production process more efficient (Villano and Fleming 2004).

Table 8: Summary of the determinants of inefficiency in sweet corn production

Variables	*Parameters*	*Coefficient*	*Standard error*	*P-value*
Inefficiency factors				
Degree of specialization (land size of sweet corn)	∂_1	1.4367	2.3408	0.5390
Off-farm activities (employment)	∂_2	2.1938	1.2602	0.0820*
Gender of the H/H (Male)	∂_3	-3.0947	1.8003	0.0860*
Education level of h/h (years)	∂_4	-1.0304	0.6813	0.1300
Household size (No.)	∂_5	1.0894	0.5913	0.0650*
Age of household head (years)	∂_6	-0.4318	0.1726	0.0120**
Land Tenure with title deed (0,1)	∂_7	5.1313	2.6119	0.0490**
Extension service (0,1)	∂_9	-0.0095	0.2852	0.9730
Hired Labour (hours)	∂_{10}	4.4932	1.8208	0.0140**
Diagnostic statistics				
Log likelihood	2.7448			
Sigma v		0.1687	0.0296	
Sample size = Population	34.0000			
Wald chi2 (6)	53333.8700			
Prob > chi2	0.0000			

** (p<0.05) * (p<0.10), Summarized from computer output (STATA)

Conclusion

This study has revealed that small-scale sweet corn farmers are not fully technically efficient, since they had a mean technical efficiency of 74% and it ranges from 31% to 93.56%, which implies that, there is room to improve efficiency by 26% in their production given the existing farm technologies. This allowance of efficiency improvement could be achieved by addressing some important policy variables that negatively and positively influenced farmers' levels of technical efficiency in the area. Only six variables significantly influence sweet corn farmers' level of technical efficiency. Off-farm activities, land ownership with title deed and use of hired type of labour had positive effects on the level of farmers' technical inefficiency hence reducing the farmers' level of technical efficiency. However, age, and gender had negative effects on farmers' technical inefficiency and thus increases the level of technical efficiency. However, this study found no statistical significant relationship of the level of education, degree of specialization and access to extension services on technical efficiency. This implies that efficiency enhancing policies should not discriminate among households based on these variables in sweet corn production. Therefore, with the available technologies, farmers can improve on their efficiency if they use family labour, which is cheaper than hired labour and acquire full ownership of their land with title deed. Besides, off-farm activities from occupations other than farming would improve the flexibility use of inputs and promote higher returns through efficient resources use for better performance if taken into consideration.

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